

5 This is a continuation of PCT Application
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1. Field of the Invention

10 The present invention relates to a structure
for mounting a heat exchanger on an automotive vehicle,
effectively applicable to an automotive vehicle with a
radiator and a condenser mounted on the front side
thereof.

15 As is well known, the radiator of a vehicle,
such as an ordinary passenger car, is mounted on the
front-end of the engine compartment (of a vehicle)
through a front-end panel of metal or resin. This front
end panel extends transversely across the vehicle and has
20 the ends thereof fixed to the body (side member) on the
vehicle side and constitutes a part of a "strength
member" (reinforcing member) of the body on the vehicle
front.

In the conventional vehicle-mounted structure of a heat exchanger, however, the heat exchanger is assembled on the front-end panel after assembling the front-end panel on the vehicle. Therefore, it is difficult to reduce the number of assembly steps and thus to reduce the production cost of the vehicle.

In view of the aforementioned problems of the prior art, the object of the present invention is to mount the heat exchanger on the vehicle with a simple structure.

35 In order to achieve the object described above,
according to the present invention, there is provided a
structure for mounting a heat exchanger on a vehicle,
characterized in that the heat exchanger mounted on the

vehicle has a dual function as a reinforcing member for reinforcing the vehicle body.

Also, according to the present invention, there is provided a vehicle-mounted structure for a heat exchanger characterized in that beam-like brackets extending transversely across the vehicle are included in the heat exchanger, which is mounted on the vehicle through the brackets.

Also, according to the present invention, there is provided a heat exchanger mounted on a vehicle, characterized by comprising a plurality of tubes for allowing a fluid to flow therethrough, header tanks arranged at the longitudinal ends of the tubes and communicating with a plurality of the tubes, and the beam-like brackets mounted on the header tanks, extending in horizontal direction and fixed on the vehicle:

Also, according to the present invention, there is provided a heat exchanger mounted on a vehicle, comprising:

a first heat exchanger comprising a plurality of first tubes for allowing a first fluid to flow therethrough and first header tanks arranged at the longitudinal ends of the first tubes for communicating with a plurality of the first tubes thereby to exchange heat between the air and the first fluid; and

a second heat exchanger including a plurality of second tubes for allowing a second fluid to flow therethrough and second header tanks arranged at the longitudinal ends of the second tubes for communicating with a plurality of the second tubes thereby to exchange heat between the air and the second fluid;

characterized in that the two heat exchangers are arranged integrally in series with each other along the direction of airflow, and the beam-like brackets extending in horizontal direction fixedly on the vehicle are coupled to at least the first header tanks.

Also, according to the present invention, there is

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provided a heat exchanger mounted on a vehicle,
comprising a plurality of tubes for allowing a fluid to
pass therethrough, header tanks arranged at the
longitudinal ends of the tubes and extending in the
5 direction perpendicular to the length of the tubes while
communicating with a plurality of the tubes, and beam-
like brackets arranged on the head tanks and extending in
horizontal direction fixedly on the vehicle,
characterized in that each header tank is formed with a
10 reinforcing wall projected in the direction perpendicular
to the length of the header tank and extending
longitudinally to the header tank.

In any case, the heat exchanger of a simple
structure free of the front-end panel can be mounted on
15 the vehicle, and therefore the number of steps of
assembling the heat exchanger can be reduced.

Also, the condenser and other heat exchangers can be
assembled removably on the reinforcing walls, which
increase the flexural rigidity (geometrical moment of
20 inertia) of the header tanks. Even in the case where the
condenser or other heat exchangers are removed,
therefore, the rigidity of the head tanks can be
prevented from decreasing.

By the way, according to this invention, each of the
25 brackets may be formed with an assembly portion for
assembling equipment other than the heat exchanger.

Also, the brackets may each be formed with an
assembly portion for assembling the headlight.

Further, the brackets may be of two types, one
30 formed with the assembly portion and the other not formed
with the assembly portion.

Furthermore, the two types of brackets and the
assembly portions may be integrated with each other.

Incidentally, the reference numerals indicated in
35 the parentheses for each means described above illustrate
the correspondence to the specific means included in the
embodiments described later.

5 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 2 is a front view of a radiator according to
10 the first embodiment.

Fig. 4 is a perspective sectional view taken in line A-A in Fig. 1.

Fig. 6 is an exploded perspective view of a heat
20 exchanger according to the second embodiment.

Fig. 8 is an exploded perspective view showing a
25 structure for mounting a heat exchanger according to a
fourth embodiment.

Fig. 10 is an exploded perspective view showing a structure for mounting a heat exchanger according to a modification of the fifth embodiment of the invention.

Fig. 11 is an exploded perspective view showing the portion of a heat exchanger having a headlight mounted thereon according to a sixth embodiment of the invention.

Fig. 12 is an exploded perspective view showing the portion of a heat exchanger having a headlight mounted

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(First embodiment)

15 The radiator 100, as shown in Fig. 2 has a radiator
core 110 and radiator tanks (first header tanks) 120, and
is well known. The radiator core 110 includes a
plurality of radiator tubes 111 for passing the cooling
water (first fluid) therethrough and fins 112 arranged
20 between the radiator tubes 111 for promoting the heat
exchange between the cooling water and the air. The
radiator tanks 120, on the other hand, are arranged on
the longitudinal ends, respectively, of the radiator
tubes (first tubes) 111 and extend in the direction
25 (vertical direction in this embodiment) perpendicular to
the length (horizontal direction in this embodiment) of
the radiator tubes 111 while at the same time
communicating with the radiator tubes.

35 The condenser 200, like the radiator 100, is configured of, as shown in Fig. 3, a condenser core 210 and condenser tanks (second header tanks) 220, and is well known. The condenser core 210 includes a plurality

of condenser tubes 211 for passing the refrigerant (second fluid) therethrough and fins 212 arranged between the condenser tubes 211 for promoting the heat exchange between the refrigerant and the air. The condenser tanks 220, on the other hand, are arranged on the longitudinal ends, respectively, of the condenser tubes (second tubes) 211 and extend in the direction (vertical direction in this embodiment) perpendicular to the length (horizontal direction in this embodiment) of the condenser tubes 211 while at the same time communicating with the condenser tubes.

By the way, at each of the upper and lower ends of the condenser core 210, a side plate 230 constituting a reinforcing member for the condenser core 210 and a center brace 131 to which a hood lock for locking a bonnet (engine hood) is secured as described later, are brazed to the condenser tank 220 together with the condenser tubes 211 and the fins 212.

The radiator 100 and the condenser 200 are integrally arranged in series with each other along the direction of air flow, as shown in Fig. 1, with the condenser 200 located upstream of the radiator 100 in the air flow. According to this embodiment, as shown in Fig. 4, the radiator 100 and the condenser 200 are integrated with each other by integrally molding the tanks 120, 220 by using, as a means for integration, extrusion or drawing of an aluminum material.

The tanks 120, 220 thus integrated are provided with beam-like brackets 300 extending horizontally and fixed to the vehicle body (side members 500). The brackets 300, which are formed by pressing an aluminum sheet, are integrally brazed to the tanks 120, 230 at the same time as the tubes 111, 211, the fins 112, 212, the tanks 120, 220 and the side plates 130, 230.

As long as an assembly (hereinafter referred to as a front end module) 410 made up of a heat exchanger 400 including the radiator 100 and the condenser 200

integrated with each other and the brackets 300 is fixed on the vehicle body (side member 500), the whole of the front end module 410 functions as what is conventionally called a "front end panel", i.e. a strength member (reinforcing member) of the vehicle body on the front side thereof.

As a result, according to this embodiment, the various vehicle parts conventionally assembled on the front end panel, including head lamps such as headlight 510, a hood lock 520 for keeping the bonnet (engine hood) closed, a resin-made air duct 420 for leading the air to the heat exchanger 400, a horn 530, various sensors 540 and a blow fan 550 are assembled on the front end module 410.

The portion of the bracket 300 extending transversely of the vehicle makes up a headlight assembly (assembling portion) 301 having built therein a housing, a reflector, a glass sheet, etc. not shown.

By the way, numeral 240 designates a refrigerant pipe made of metal and brazed to the bracket 300. The air duct 420 is secured to the heat exchanger 400 by fastening means such as bolts.

Now, the features of this embodiment will be explained.

The front end module 410 including the heat exchanger 400 and the brackets 300 is mounted on the vehicle while functioning as a strength member of the vehicle body. Therefore, the heat exchanger 400 can be mounted on the vehicle with a simple structure free of the front end panel, and the number of the steps for assembling the heat exchanger 400 can be reduced.

Also, in view of the fact that the front end module 410 functions as a strength member of the vehicle body, the various parts (hereinafter referred to as the front end parts) conventionally assembled on the front end panel are not individually assembled on the vehicle. Instead, the front end parts are assembled on the front

end module 410 in advance, and then the front end module 410 is assembled on the vehicle. In this way, the heat exchanger 400 and the front end parts can be assembled on the vehicle in one step. As a result, the number of the vehicle assembly steps can be reduced, thereby making it possible to decrease the vehicle production cost.

(Second embodiment)

In the first embodiment, the radiator tanks 120 and the condenser tanks 220 are integrally formed, and therefore the radiator 100 and the condenser 200 cannot be separated from each other. According to the second embodiment, on the other hand, only the radiator 100 is mounted at the time of vehicle production (shipment from the factory), and the condenser 200 (vehicle air climate control system) can be mounted after shipment from the factory (for example, by vehicle dealers).

Specifically, as shown in Figs. 5 and 6, a reinforcing flange (reinforcing wall) 121 having an L-shaped section projected in the direction (upstream in the air flow according to this embodiment) perpendicular to the length of the radiator tank 120 and extending longitudinally of the radiator tank 120 is integrally formed with the radiator tank 120 by extrusion or drawing.

As a result, the condenser 200 can be easily assembled and secured in position on the radiator 100 by inserting the condenser 200 between the reinforcing flange 121 and the radiator tank 120, as shown in Fig. 6.

The front module 410 on which the condenser 200 has yet to be assembled and which includes only the radiator 100 may have a smaller function (lower strength) as a vehicle reinforcing member. According to this embodiment, however, the provision of the reinforcing flange 121 projected in the direction perpendicular to the length of each radiator tank 120 increases the flexural rigidity (geometrical moment of inertia) of the radiator tank 120, and therefore can prevent the adverse

effect on the function as a vehicle reinforcing member.

As a result, according to this embodiment, the condenser 200 can be rendered removable without adversely affecting the function of the front end module 410 as a reinforcing member.

(Third embodiment)

In the first and second embodiment, the radiator 120 is made of metal (aluminum). According to the third embodiment, on the other hand, a radiator 120 made of a resin is employed.

According to this embodiment, as shown in Fig. 7, the radiator tanks 120 made of resin are located at the upper and lower ends, respectively, of the radiator core 110 in a vertical position coinciding with the length of the radiator tubes 111, and a bracket 300 formed of a resin material is integrated with the radiator tank 120.

By the way, according to this embodiment, in addition to the bracket 300 (hereinafter referred to as the first bracket 300 in the following embodiments), second brackets 310 made of metal (aluminum) extending in horizontal direction from the condenser tanks 220, respectively, and fixed on the vehicle are brazed to the condenser tanks 220, respectively. The condenser 200 is integrally secured to the radiator 100 by fastening (fixing) means such as bolts. Incidentally, according to this embodiment, each headlight 510 is assembled on the corresponding second bracket 310.

As a result, according to this embodiment, the first bracket 300 formed integrally with one of the radiator tanks 120, the second brackets 310 integrated with the condenser tanks 220, respectively, the radiator 100 and the condenser 200 make up a front end module 410.

The second brackets 310, though made of metal in this embodiment, are not limited to metal, but may be made of resin or other materials. Also, the metal portions are joined not necessarily by brazing but may be joined by other fastening means such as welding or bolts.

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(Fourth embodiment)

According to this embodiment, as in the second embodiment, the condenser 200 can be assembled, after shipment from the factory, on the radiator 100 having the radiator tanks 120 made of resin.

Specifically, as shown in Fig. 8, the second brackets 310 are brazed to the radiator 110 while at the same time brazing the air duct 420 of metal (aluminum) to the second brackets 310.

The second brackets 310 are each formed to include a portion constituting a bracket body 311 brazed to the radiator core 110 and an arm 312 extending horizontally from the bracket body 311. In order to enable the bracket body 311 to exhibit a similar function to the reinforcing flange 121 (see the second embodiment shown in Figs. 5 and 6), the bracket body 311 has a section substantially in the shape of an arc corresponding one half of a circle or an L.

The method of joining the second brackets 310 is not limited to brazing, but may use such fastening means as welding or bolts. Also, the air duct 420, if made of resin, is desirably assembled on the second brackets 310 by the fastening means such as bolts.

(Fifth embodiment)

According to this embodiment, as shown in Figs. 9 and 10, the first and second brackets 300, 310 are integrated with a housing 511 (the assembly in claims) on which the headlight is assembled. Each of the resulting bracket units 320 thus integrated is integrated with (integrally assembled on) the corresponding radiator tank 120 by joining means such as brazing or welding or by fastening means such as bolts.

In this embodiment, Fig. 9 shows an example of arrangement in which the longitudinal direction of the radiator tank 120 coincides with the vertical direction. On the other hand, Fig. 10 shows a modification as an example of arrangement in which the longitudinal

direction of the radiator tank 120 coincides with the horizontal direction.

According to this embodiment, in the case where the bracket unit 320 is assembled on the corresponding radiator tank 120 by fastening means such as bolts, the two may be fixedly assembled to each other through an elastic member such as a rubber vibration isolator. As another alternative, the bracket unit 320 and the headlight 510 may be integrated with each other.

(Sixth embodiment)

In this embodiment, as shown in Fig. 11, the first bracket 300 is integrated with the headlight housing 511 to be assembled, and the resultant assembly is integrated with (integrally assembled on) the radiator tank 120 by joining means such as brazing or welding or by fastening means such as bolts. At the same time, the second brackets 310 formed separately from the first brackets 300 are integrated with (integrally assembled on) the radiator tank 120 by joining means such as brazing or welding or by fastening means such as bolts.

(Seventh embodiment)

In this embodiment, as shown in Fig. 12, a second bracket 310 is integrated with a corresponding headlight housing 511 making up an assembling portion, and the resultant assembly is integrated with (integrally assembled on) the radiator tank 120 by the condenser and the radiator. At the same time, the first brackets 300 formed separately from the second bracket 310 are integrated with (integrally assembled on) the radiator tank 120 by joining means such as brazing or welding or by fastening means such as bolts.

(Other embodiments)

Each of the embodiments described above refers to a heat exchanger in which the condenser of the air climate control system and the radiator for cooling the engine are integrated with each other. The type of heat exchanger, however, is not limited to those described in

Also, the means for integrating the condenser and the radiator with each other is not limited to the joining means such as brazing or welding, but may be fastening means such as bolts.

15 Furthermore, instead of fixing the air duct 420 to the heat exchanger 400 by joining means such as bolts in the first embodiment, the air duct 420 may be made of a metal and coupled to the heat exchanger 40 by joining means such as brazing or welding.

20 By the way, in this invention, the mounting portion refers to the portion of the heat exchanger 400 on which the headlight housing is mounted independently as designated by reference numeral 511 in Figs. 10 to 13, or the portion (assembling portion) of the heat exchanger
25 400 on which the headlight 510 is mounted through some member as designated by reference numeral 301 in Figs. 1 and 9.

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